Crystallization and Structure Formation in Model Polymer Blends

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Time-resolved synchrotron wide- and small-angle x-ray scattering experiments were used to investigate the crystallization behavior and microstructure development of poly(ethylene oxide) [PEO] and melt-miscible PEO blends. Model blends were prepared with both weakly interacting poly(methyl methacrylate) and strongly interacting poly(styrene-co-hydroxystyrene) [SHS]. Our previous results on blends of polydisperse polymers [1] showed that average SAXS long periods and lamellar thicknesses decreased at early crystallization times: by 2-3 nm for PEO and blends containing low T_g diluents and by 5-9 nm for blends containing higher T_g diluents. However, these previous crystallization/melting experiments suggested that there was a significant influence of molecular weight segregation during crystallization. To isolate/remove the molecular weight segregation effect, we performed similar experiments on neat PEO and blends having relatively narrow molecular weight distributions. Two PEO molecular weight fractions (M_w = 50,000, PDI = 1.07; M_w = 334,500, PDI = 1.14), two PMMA fractions (M_w = 17,900, PDI = 1.06; M_w = 177,800, PDI = 1.08), and two SHS 'fractions' (M_w = 31,700, PDI = 1.50; M_w = 72,700, PDI = 2.10) were prepared. Isothermal crystallization experiments were conducted on the PEO fractions, mixtures of PEO fractions, PEO/PMMA blends, and PEO/SHS blends on beamline X27C in April and September. The initial decrease in microstructure parameters is similar to that of the polydisperse polymers, however, multiple crystallization processes ('secondary' crystallization, with n near 1) are observed for both high and low molecular weight PEO fractions. Further detailed analysis is underway.

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References: 1. M. S. Lisowski, Q. Liu, J. D. Cho, J. Runt, F. Yeh and B. S. Hsiao, "Crystallization Behavior of Poly(ethylene oxide) and Its Blends Using Time-Resolved Wide- and Small-angle X-ray Scattering," Macromolecules *33, 4842*, 2000**.**